SOLUTIA
Solutions for a better life.

Solutia Inc.
575 Maryville Centre Drive
St. Louis, Missouri 63141

P.O. Box 66760
St. Louis, Missouri 63166-6760
Tel 314-674-1000

August 2, 2010

Mr. Kenneth Bardo - LU-9J
U.S. EPA Region V
Corrective Action Section
77 West Jackson Boulevard
Chicago, IL 60604-3507

VIA FEDEX

Re: Route 3 Drum Site Groundwater Monitoring Program
Evaluation of 3Q08 - 2Q10 Data
Solutia Inc., W. G. Krummrich Plant, Sauget, IL

Dear Mr. Bardo:

As noted when the 2nd Quarter 2010 Data Report for the subject program was submitted July 22, enclosed please find a report evaluating all of the Drum Site monitoring data collected from 3rd quarter 2008 through 2nd quarter 2010, i.e., since the February 2008 Final Decision, and making recommendations for changes going forward. Reiterating those recommended changes from the enclosed report:

- reduce sampling frequency from quarterly to annually during the third quarter of each year; and

- continue to maintain (mow) the site every April, July, and October, but reduce inspections from those months to annually in the third quarter.

I'd appreciate your prompt response because the 3rd quarter 2010 sampling is scheduled to take place this month.

If you have any questions or comments regarding this report, please contact me at (314) 674-3312 or gmrina@solutia.com

Sincerely,

Gerald M. Rinaldi
Manager, Remediation Services

Enclosure

cc: Distribution List

DISTRIBUTION LIST

Route 3 Drum Site Groundwater Monitoring Program
Evaluation of 3Q08 - 2Q10 Data
Solutia Inc., W. G. Krummrich Plant, Sauget, IL

USEPA

Stephanie Linebaugh
USEPA Region 5 - SR6J, 77 West Jackson Boulevard, Chicago, IL 60604

IEPA

James Moore
IEPA Bureau of Land, 1021 North Grand Avenue East, Springfield, IL 62706

Booz Allen Hamilton

Dan Briller
Booz Allen Hamilton, 8283 Greensboro Drive, McLean, VA 22102

Solutia

Justin Prien 500 Monsanto Avenue, Sauget, IL 62206-1198

URS

Technical Memorandum

Date: July 29, 2010

To: Jerry Rinaldi - Solutia Inc.

cc: Bob Billman – URS Corporation, St. Louis

From: Wade A. Narin van Court, P.E. – URS Corporation, Hallowell, Maine

Subject: **2nd Quarter 2010 Evaluation of Groundwater Monitoring at the W. G. Krummrich Facility Illinois Route 3 Drum Site**

1.0 INTRODUCTION

The Illinois Route 3 Drum Site (hereafter referred to as "the Site") is a part of the Solutia Inc. (Solutia) W. G. Krummrich Facility (hereafter referred to as "the Facility") located in Sauget, Illinois. The U.S. Environmental Protection Agency (USEPA) issued a Final Decision on February 26, 2008, that specified the preparation and submission of an Operation and Maintenance (O&M) Plan for the Site and, upon approval, implementation of that plan. That plan (submitted May 23, 2008, and approved June 19, 2008) called for monitoring the groundwater quality at the Site by collecting and analyzing samples from monitoring wells GM-31A and GM-58A, which are screened in the Shallow Hydrogeologic Unit (SHU). As shown on **Figure 1**, monitoring well GM-31A is located near the drum disposal area and monitoring well GM-58A is located slightly downgradient.

The O&M plan was developed by Solutia to meet the requirements of the Final Decision. The activities implemented under the O&M plan include collecting quarterly groundwater samples from two monitoring wells. During the monitoring rounds, samples were obtained using low-flow sampling techniques. Indicator parameters monitored during purging of the wells using a flow cell include pH, temperature, specific conductance, redox potential, and dissolved oxygen. Groundwater samples collected during the sampling events are analyzed for the following constituents of interest (COI): biphenyl; 1-chloro-2,4-dinitrobenzene; 2-chloronitrobenzene; 3-chloronitrobenzene; 4-chloronitrobenzene; 2,4-dichlorophenol; nitrobenzene; 2-nitrobiphenyl; 3-nitrobiphenyl; 4-nitrobiphenyl; pentachlorophenol; and 2,4,6-trichlorophenol. Note that 2-chloronitrobenzene and 4-chloronitrobenzene were analyzed together and not as separate compounds.

As part of the O&M plan, the effectiveness of monitored natural attenuation (MNA) of the COI is to be evaluated. This memorandum provides such an assessment.

At the Site, MNA will be evaluated based upon the following:

1. A demonstration of a clear and meaningful trend of decreasing contaminant mass or concentration; and
2. An indirect demonstration of the types and rates of natural attenuation processes active at the Site.

The assessment presented in this memorandum is focused specifically on the following COIs: 1-chloro-2,4-dinitrobenzene; 2-chloronitrobenzene/4-chloronitrobenzene; 2-nitrobiphenyl; and 2,4,6-trichlorophenol. The other eight COI were not found at the detection limits during any of the sampling rounds. Following a brief review of the relevant background information at the Site in **Section 2.0** and the properties and natural attenuation mechanisms of the COI in **Sections 3.0** and

4.0, the evaluation of MNA at the Site, based upon the data collected to date, is presented in **Section 5.0**. Conclusions and recommendations are presented in **Sections 6.0 and 7.0**, respectively.

2.0 RELEVANT BACKGROUND INFORMATION

A number of investigations had been performed to characterize the Facility and its groundwater characteristics prior to starting the current O&M at the Site. In particular, these investigations obtained data used to determine the aquifer characteristics and existing hydrogeologic conditions. The existing information relevant to the evaluation of MNA is discussed in the following sections.

2.1 AQUIFER CHARACTERISTICS

Aquifer characteristics need to be considered when evaluating MNA. For example, groundwater velocities, which are determined by hydraulic properties, e.g., hydraulic conductivity and effective porosity, are used to calculate attenuation rate constants, as described later in this memorandum.

Based on the description from the Technology Selection Report (Booz Allen Hamilton, 2007), soils beneath the Site consist of poorly-sorted fine and medium sands with traces of silt and gravel and occasional clay lenses. In the Site vicinity, depth to bedrock is approximately 110 feet below the ground surface (bgs), and approximately 140 feet below the crest of 30-foot high levees along the banks of the Mississippi River.

Three distinct hydrologic units have been identified in the unconsolidated soil which, downward from the ground surface, are the shallow hydrologic unit (SHU), the medium hydrologic unit (MHU) and the deep hydrologic unit (DHU). The SHU is approximately 30 feet thick; the MHU and DHU are each approximately 40 feet thick and are similar in composition. With the exception of BSA source area well BSA-MW-01S, the wells monitored for MNA parameters are screened in the DHU. Based upon the similarity in grain-size composition, aquifer properties for SHU, MHU and DHU were assumed to be similar for this MNA evaluation. The aquifer properties used in the analyses of MNA are summarized in **Table 1**, below.

Table 1: Typical Soil Properties

Soil Property	Value Used in MNA Evaluation Analyses (Source: URS, 2008 unless noted)
Hydraulic Conductivity (K)	1.75×10^{-2} centimeters per second (cm/sec)
Hydraulic Gradient (i)	0.0014 feet/foot
Bulk Density (ρ_b, dry unit weight)	118.3 pounds per cubic foot (1,895 kilograms per cubic meter)
Porosity (n)	28.8%
Effective Porosity (n_e)	20% (Env. Tech., 1997)
Fraction Organic Carbon (f_{oc})	0.0016

2.2 SITE HYDROGEOLOGY

Hydrogeologic conditions are also an important consideration when evaluating MNA. Site data were reviewed to develop an understanding of the hydrogeologic conditions that could influence the

interpretation of the occurrence and extent of MNA. Relevant hydrogeologic conditions at the Site at briefly discussed below.

An important hydrologic feature that affects groundwater flow beneath the Site is the Mississippi River, which is interpreted to typically be the groundwater discharge point for all three hydrologic units. However, the groundwater that discharges into the Mississippi River is not adversely affecting water quality, based on the results of past and ongoing surface water and sediment sampling.

Since Spring 2006[1], the stage of the Mississippi River downgradient of the Site has varied over 30 feet, from an approximate elevation of 380 feet mean sea level (MSL) to 410 feet MSL. During periods when the stage is raised (i.e., generally above elevation 390 feet MSL), it has been observed to be higher than groundwater levels in the MHU and/or DHU immediately adjacent to the river, and presumably in the SHU. As such, higher water levels may mobilize COI from the vadose zone at the Site into groundwater.

Another consideration that may affect the transport of COI from the Site is the Groundwater Migration Control System (GMCS) installed at Sauget Superfund Site R, which is adjacent to the Mississippi River and south to southwest of the Site. The GMCS consists of a three-sided vertical barrier and groundwater extraction wells. The barrier is keyed into the underlying bedrock and open to the west, so groundwater from impacted areas to the east are intercepted while the amount of river water intercepted by the extraction wells is minimized. During normal river conditions, the extraction pumps operate to create a groundwater gradient that captures groundwater flow into the GMCS from the east.

3.0 PROPERTIES OF CONSTITUENTS OF CONCERN AND NATURAL ATTENUATION

The COI that are the focus of this evaluation include 1-chloro-2,4-dinitrobenzene; 2-chloronitrobenzene/4-chloronitrobenzene; 2-nitrobiphenyl; and 2,4,6-trichlorophenol in monitoring well GM-31A and 1-chloro-2,4-dinitrobenzene and 2-nitrobiphenyl in monitoring well GM-58A. Note that 2-chloronitrobenzene/4-chloronitrobenzene and 2,4,6-trichlorophenol were not detected in monitoring well GM-58A.

Natural attenuation involves a reduction of the concentration and/or mass of a given COI in groundwater through several processes that can include the following:

- **Dispersion** – a reduction in concentration of a COI as a result of the expansion of a plume during advective transport;
- **Dilution** – a reduction in concentration of a COI generally through recharge over the area of the plume or due to mixing with clean groundwater;
- **Sorption** – a reduction in the dissolved concentration of a COI through sorption to organic carbon or metallic oxides on mineral surfaces in soil matrix or bedrock fractures;
- **Volatilization** – a reduction in the dissolved or sorbed concentration of a COI due to partitioning (diffusion) from soil or groundwater into soil vapor;

[1] The first quarterly event for the Plume Stability Monitoring Program conducted at the Facility occurred in March 2006.

- **Chemical Transformation** – a reduction in concentration and mass of a constituent of interest through abiotic processes such as hydrolysis; and

- **Biodegradation** – a reduction of both the mass and concentration of a COI through biologically mediated reactions that are facilitated by native microorganisms living on the soil. Biodegradation is the primary attenuation mechanism that results in the destruction of organic compounds and a reduction in contaminant mass.

The vast majority of these processes are, in all likelihood, contributing to MNA of the COI.

Chemical properties of the COI that may affect the natural attenuation processes described above include Henry's Law Constant (volatilization), along with solubility and organic carbon partitioning coefficients (sorption and biodegradation). For the COI being evaluated, these properties are summarized in **Table 2**. Following is a general discussion of these data and their importance to natural attenuation processes.

Table 2: Chemical Properties for COI
(Sources: MSDS for the COI; Bockting et al., 1993; Sanders, 1999)

Constituent of Interest	Density (grams / milliliter)	Henry's Law Constant (atmospheres-cubic meters/mole at 25 °C)	Solubility (milligrams/liter [mg/l] at 20°C)	Organic Carbon Partitioning Coefficient (K_{oc}, liters/ kilogram)
1-Chloro-2,4-Dinitrobenzene	1.305	3.15×10^{-7}	270	1.39×10^{3}
2-Chloronitrobenzene/ 4-Chloronitrobenzene	1.3	Not Available	307 / 154	3.71×10^{2} / 6.92×10^{2}
2,4,6-Trichlorophenol	1.675	Not Available	100	4.37×10^{2}
2-Nitrobiphenyl	1.49	Not Available	Not Available	Not Available

The density of the COI presented above are representative of the compounds when present as a pure phase and provide information that can be used to infer the vertical position of where the most significant impacts in a groundwater system might occur. The COI are denser than water and when released in sufficient quantities, may penetrate to depths below the phreatic surface. The plumes generated from compounds denser than water can exhibit high and sometimes uniform concentrations over a large thickness of the aquifer.

Volatilization can be an important transfer mechanism for compounds that exhibit a Henry's Law Constant higher than 10^{-5} atm-m^3/mol. Based upon the available data, the COI are compounds that do not readily partition from groundwater into soil vapor, so volatilization is not expected to be an attenuation mechanism for the COI in groundwater at this Site.

The solubilities of the COI are relevant with respect to MNA in that more soluble compounds typically tend to be more readily biodegradable. Since the COI are slightly soluble in water, this indicates that these compounds may not be readily biodegraded.

The organic carbon partitioning coefficients of COI are greater than 200 liters per kilogram. Therefore, these COI are expected to adsorb appreciably to organic carbon in the soil, suspended solids, or

sediments and sorption may be an important attenuation process for reducing concentrations of COI in groundwater.

4.0 BIODEGRADATION MECHANISMS

Biodegradation of the chloronitrobenzenes (i.e., 1-chloro-2,4-dinitrobenzene and 2-chloronitrobenzene/4-chloronitrobenzene) tend to occur under both aerobic and anaerobic conditions. In general, there is very little information on the biodegradation of these COI and biodegradation is considered to occur relatively slowly. Based on the information for the biodegradation of chloronitrobenzenes that was presented by van Agteren et al. (1998), aerobic micro-organisms use these COI for growth and anaerobic micro-organisms cometabolize these COI, particularly using nitrate, ferric iron (Fe^{3+}), or carbon dioxide as electron acceptors. Information on biodegradation of 2-nitrobiphenyl and 2,4,6-trichlorophenol, as well as degradation reactions for any of the COI, were not available in the literature.

5.0 ASSESSMENT OF NATURAL ATTENUATION

This demonstration of MNA involves the following lines of evidence:

- **Primary evidence:** Primary lines of evidence of MNA include declining concentrations of COI that coincide with increases in certain biodegradation products (e.g., carbon dioxide and/or methane) or concentrations that are indicate stable or decreasing.

- **Secondary evidence:** Secondary lines of evidence of MNA include depleted concentrations of electron acceptors (e.g., dissolved oxygen, nitrate, and sulfate) within the boundaries of the plume.

Evaluation of these lines of evidence is discussed in the following sections.

5.1 TRENDS IN COI CONCENTRATIONS

To assess the primary lines of evidence of MNA, URS reviewed existing analytical data for COI in monitoring wells GM-31A and GM-58A that was obtained quarterly over the past two years (i.e., eight sets of data). This review included: 1) plotting the change in concentration over time in each well; and 2) assessing the suitability of performing a statistical analysis of the COI analytical data using the Mann-Kendall Statistic to evaluate trends in the COI concentrations over time under similar water level and potentiometric conditions. Concentrations of COI and selected electron acceptors, along with water levels observed in the wells, were plotted chronologically by monitoring event to determine if there was a seasonal correlation between concentration and water levels. In addition, the potentiometric groundwater surfaces were reviewed to determine which monitoring events occurred under similar groundwater conditions.

5.1.1 Change in COI Concentrations with Time

Plots for each well were developed to evaluate changes in the COI concentrations and potential oxidation and transformation products generated during the biodegradation of these COI (e.g., ferrous iron [Fe^{2+}] and carbon dioxide and methane, respectively) over time. These plots were reviewed to

assess if the COI were attenuating, in which case one would expect to see concentrations of COI decrease, and concentrations of potential transformation products from biodegradation increase, over time. Plots of the data for each quarterly monitoring round from 3Q08 through 2Q10 are presented in **Figures 2A** and **2B** for monitoring wells GM-31A and GM-58A, respectively. The findings of our review are summarized in **Table 3** and discussed below. Supporting information is presented in **Attachment A**.

Review of the data indicates that there is generally no change in the COI concentrations over time, but the data indicate there may be a decrease in 2-chloronitrobenzene/4-chloronitrobenzene concentrations at each well. However, the data do not show a clear decreasing trend in the concentrations of 2-chloronitrobenzene/4-chloronitrobenzene. The trends in the transformation products and electron acceptors are discussed in **Section 5.2**.

5.1.2 Change in COI Concentrations with Distance

Comparisons of the two wells were also developed to evaluate changes over distance for the COI. These comparisons were reviewed to assess if the COI were attenuating as they moved downgradient from monitoring well GM-31A to GM-58A, in which case one would expect to see concentrations of COI decrease between the wells. Comparisons of COI concentrations from 3Q08 through 2Q10 are presented in **Figure 3.** The findings of our review are summarized in **Table 3** and discussed below. Supporting information is presented in **Attachment A**.

Table 3
Change in COI Concentrations with Time and Distance

Constituents of Interest (COI)	Change with Time	Change with Distance (GM-31A to GM-58A)
1-Chloro-2,4-Dinitrobenzene	GM-31A: No change GM-58A: Non-detect all rounds	Decreases to non-detect
2,4,6-Trichlorophenol	GM-31A: No change GM-58A: Generally non-detect	Decreases to non-detect
2-Chloronitrobenzene/ 4-Chloronitrobenzene	GM-31A: Possible decrease GM-58A: Possible decrease	Apparent decrease after time lag
2-Nitrobiphenyl	GM-31A: No change GM-58A: Non-detect all rounds	Decreases to non-detect

The following observations are based on our review of the COI data and changes over time and distance:

1. There is generally no change in the COI concentrations over time. Although there may be a decrease in 2-chloronitrobenzene/4-chloronitrobenzene concentrations at each well, the data do not clearly show a trend.

2. COI concentrations generally appear to decrease between wells GM-31A and GM-58A. In particular, the concentrations of 1-chloro-2,4-dinitrobenzene; 2-nitrobiphenyl; and 2,4,6-trichlorophenol generally decrease to non-detectible levels in monitoring well GM-58A.

3. Concentration of 2-chloronitrobenzene/4-chloronitrobenzene appears to decrease between GM-31A and GM-58A. In addition, there appears to be a time lag of approximately one quarter

between the wells. For example, a peak concentration observed in GM-31A is followed by a peak in GM-58A approximately one quarter after appearing in GM-31A. Furthermore, when the peak apparently reaches GM-58A, the concentration is generally lower than the concentrations observed in GM-31A.

5.1.3 Mann-Kendall Analysis

The O&M plan states that the sample results will be analyzed to determine if any statistically significant changes have occurred. This analysis was performed using the non-parametric Mann-Kendall Test, combined with the coefficient of variation (CV) test, to evaluate the significance of trends of COI in groundwater at the Site. The Mann-Kendall Test is considered to be appropriate for evaluating trends in the data for the following reasons:

- This test is designed to handle data that are non-parametric (i.e., do not exhibit a specific distribution such as normal or log normal);
- Data set can contain data collected at irregularly spaced intervals in time; and
- Data set can contain elevated (outlier) values compared to the average or non-detect results.

The Mann-Kendall Test was performed using the spreadsheet provided by the State of Wisconsin Department of Natural Resources Remediation and Redevelopment Program (WIDNR Form 4400-215, dated February 2001). The WIDNR spreadsheet evaluates trends in data over time at the 80% and 90% confidence levels. If no trend exists at the 80% confidence level, the spreadsheet will evaluate the stability of the data. The WIDNR spreadsheet was revised by URS to also evaluate trends at the 95 % confidence level.

Performing the Mann-Kendall Test with the WIDNR spreadsheet will provide one of several different trend and stability results for a given data set. These results, as well as what they mean, are as follows:

1. Trend Results:
   - Increasing – a sufficient number of data points are greater than the previous data points, so the Mann-Kendall Statistic (S) is greater than the absolute value of the critical Mann-Kendall Statistic (S_{cr}) for the given confidence level.
   - Decreasing – a sufficient number of data points are less than the previous data points, so the Mann-Kendall Statistic (S) is less than the critical Mann-Kendall Statistic (S_{cr}) for the given confidence level.
   - No Trend – does not meet the criteria for increasing or decreasing trends.
   - $n<4$ – an insufficient number of data points that are considered to be valid to perform the Mann-Kendall Test (i.e., less than 4 valid data points), so data could not be analyzed.

2. Stability Results:

   - Stable – A trend could not be determined at the 80% confidence level and the covariance is less than 1.0.

   - Non-Stable – A trend could not be determined at the 80% confidence level and the covariance is greater than or equal to 1.0.

   - NA – Not Analyzed; stability could not be determined at the 80% confidence level because the Mann-Kendall Statistic (S) was greater than the number of events in the analysis.

   - n<4 – an insufficient number of data points that are considered to be valid to perform the Mann-Kendall Test (i.e., less than 4 valid data points), so data could not be analyzed.

The Mann-Kendall Test is not valid for unadjusted data that exhibits seasonal behavior (i.e., data that is not seasonally consistent). Seasonal behavior of the MNA data (i.e., from 3Q08 through 2Q10) from the wells were evaluated in two ways. First, as noted above, the potentiometric contours for the Facility are affected by seasonal water level changes, which are expected to result in seasonal variations in the COI concentrations. Second, COI concentrations and groundwater levels measured during each sampling event were plotted versus time. For monitoring wells GM-31A and GM-58A, concentrations of COI and groundwater elevations tend to exhibited parallel or inverse trends, which is consistent with the concentrations being seasonally affected. As noted above, the data obtained during 3Q08, 4Q08, 1Q09, 3Q09, and 1Q10 appeared to be seasonally consistent. The 2Q09, 4Q09 and 2Q10 data was obtained during very high river stages and do not appear to be seasonally consistent with the other data obtained during the two years of monitoring. Therefore, there were considered to be seasonally valid data from five monitoring events, which were used for the Mann-Kendall Test analysis.

The results of the trend analyses for the COI in each monitoring well are summarized below in **Table 4** and supporting information is presented in **Attachment B**.

Table 4
Summary of Results of Mann-Kendall Trend Test and Stability Analysis

Monitoring Well	1-Chloro-2,4-Dinitrobenzene		2,4,6-Trichlorophenol	
	Trend ≥ 90% Confidence Level	Stability	Trend ≥ 90% Confidence Level	Stability
GM-31A	No Trend	STABLE	No Trend	STABLE
GM-58A	n<4	n<4	No Trend	STABLE
Monitoring Well	**2-Chloronitrobenzene/ 4-Chloronitrobenzene**		**2-Nitrobiphenyl**	
	Trend ≥ 90% Confidence Level	Stability	Trend ≥ 90% Confidence Level	Stability
GM-31A	No Trend	STABLE	No Trend	STABLE
GM-58A	No Trend	STABLE	n<4	n<4

Note: n<4 - insufficient valid data for analysis because all of the analytical results used in the analysis were below detection limits (i.e., non-detect).

The Mann-Kendall Test evaluation of the data indicated that there were no decreasing or increasing trends in the COI concentrations at the 90% confidence level during the past eight quarters. Furthermore, the concentrations of the COI were stable during the past eight quarters.

5.2 Trends in Transformation Products and Electron Acceptors

Plots for each well were developed to evaluate changes in the concentrations of the electron acceptors (e.g., dissolved oxygen, sulfate, and ferric iron [Fe^{3+}]) and potential oxidation and transformation products generated from the biodegradation of the COI (e.g., ferrous iron [Fe^{2+}] and carbon dioxide and methane, respectively) over time and distance. These plots were reviewed to assess if MNA was occurring, in which case one would expect to see concentrations of electron acceptors decrease, and concentrations of potential transformation products increase, over time. Plots of the data from the quarterly monitoring rounds (3Q08 through 2Q10) are presented in **Figures 2A** and **2B** for monitoring wells GM-31A and GM-58A, respectively.

Changes in concentrations of sulfate, ferric iron, ferrous iron, carbon dioxide, methane, dissolved oxygen and ORP with distance that appeared to be occurring at the Site and downgradient of the Site are summarized in **Table 5** and briefly discussed below. Supporting information is presented in **Attachment A**.

Table 5
Change in Concentration of Electron Acceptors and By-Products with Distance and Time

Electron Acceptors or By-Products	Change with Distance	Change with Time	Supports Finding of Natural Attenuation
Sulfate (SO_4^{2-})	Generally decreases	GM-31A: No change GM-58A: No change	Yes
Ferric Iron (Fe^{3+})	Generally decreases	GM-31A: Decreases GM-58A: Decreases	Yes
Ferrous Iron (Fe^{2+})	No change	GM-31A: Low, no change GM-58A: Low, no change	Inconclusive
Carbon Dioxide (CO_2)	No change	GM-31A: Elevated, no change GM-58A: Elevated, no change	Inconclusive
Methane (CH_4)	No change	GM-31A: Low, varies with GWT GM-58A: Low, varies with GWT	Inconclusive
Dissolved Oxygen (DO)	No change	GM-31A: Possible decrease GM-58A: Possible decrease	Inconclusive
Oxidation-Reduction Potential (ORP)	No change or increases	GM-31A: Varies with GWT GM-58A: Varies with GWT	In range for sulfate and ferric iron reduction

Note: GWT refers to the level of the groundwater table.

The following observations are based on our review of the concentration data for the Drum Site:

1. Decreases in sulfate and ferric iron indicate that electron acceptors are being utilized.

2. Ferrous iron concentrations are low and do not appear to change over time or between the wells.

3. CO_2 concentrations generally appear to be elevated with little change over time or between the wells.

4. Methane concentrations are low (between 1 and 15 ug/L) and appear to vary with the groundwater elevation. When the groundwater elevation increases, the methane concentration increases, which may be due to nutrients mobilized from the vadose zone.

6.0 CONCLUSIONS

Our evaluation of the data from the groundwater monitoring conducted from 3Q08 through 2Q10 indicates the following:

1. The concentrations of the COI appear to decrease with distance from the source. Of the four COI detected in monitoring well GM-31A (1-chloro-2,4-dinitrobenzene; 2-chloronitrobenzene/ 4-chloronitrobenzene; 2-nitrobiphenyl; and 2,4,6-trichlorophenol), all but 2-chloronitrobenzene/ 4-chloronitrobenzene were generally at concentrations below the detection limits in monitoring well GM-58A, which is located slightly downgradient.

2. Concentrations of 2-chloronitrobenzene/4-chloronitrobenzene appear to decrease between GM-31A and GM-58A. Additionally, there appears to be a time lag of approximately one quarter between peaks observed in GM-31A and GM-58A.

3. The data exhibit seasonal behavior, so the Mann-Kendall Test was performed using data determined to be seasonally consistent to determine statistical trends in the concentrations of the COI over time. The valid monitoring events were 3Q and 4Q 2008; and 1Q and 3Q 2009; and 1Q 2010; the data from 2Q09, 4Q09 and 2Q10 were obtained during non-typical (i.e., seasonally inconsistent) groundwater conditions.

4. The Mann-Kendall Test indicates that the COI concentrations above the detections limits in monitoring wells GM-31A and GM-58A are stable.

7.0 RECOMMENDATIONS

Supported by data collected during this evaluation, listed below are recommendations for changes to the Illinois Route 3 Drum Site groundwater monitoring program:

1. Reduce sampling frequency to annually, with sampling events occurring during the third quarter of each year. This recommendation is consistent with US EPA's January 2007 "Technology Selection Report – Solutia Inc. W. G. Krummrich Facility, Sauget, Illinois."

2. Continue to maintain (mow) the site every April, July, and October, but reduce inspections to annually in third quarter of each year.

REFERENCES

Bockting, G.J.M., E.J. van de Plassche, J. Struijs, and J.H. Canton, 1993, *Soil-water Partition Coefficients for Organic Compounds*, National Institute of Public Health and Environmental Protection, Bilthoven, The Netherlands, Report No. 679101013.

Env. Tech. (1997) *1997 Resource Guide*, Environmental Technology, page 90.

MI (2009) Microbial Insights Data Package, Appendix G in 1st Quarter 2009 Data Report, Long-Term Monitoring Program, Solutia Inc. W.G. Krummrich Facility, prepared by URS Corporation, May 2009.

Charles J. Newell, Hanadi S. Rifai, John T. Wilson, John A. Connor, Julia A. Aziz, and Monica P. Suarez (2002) "Calculation and Use of First-Order Rate Constants for Monitored Natural Attenuation Studies," United States Environmental Protection Agency National Risk Management Research Laboratory, Groundwater Issue, EPA/540/S-02/500, November 2002.

Sanders, Rolf, 1999, *Compilation of Henry's Law Constants for Inorganic and Organic Species of Potential Importance in Environmental Chemistry*, Version 3, from website: http://www.mpch-mainz.mpg.de/~sander/res/henry.html, downloaded 9 July 2010.

URS (2008) Sauget Area 2, Remedial Investigation Report, prepared by URS Corporation, October 2008.

URS (2008) 3rd Quarter 2008 Data Report, Illinois Route 3 Drum Site Groundwater Sampling, Solutia Inc. W.G. Krummrich Facility, prepared by URS Corporation, December 2008.

URS (2009) 4th Quarter 2008 Data Report, Illinois Route 3 Drum Site Groundwater Sampling, Solutia Inc. W.G. Krummrich Facility, prepared by URS Corporation, March 2009.

URS (2009) 1st Quarter 2009 Data Report, Illinois Route 3 Drum Site Groundwater Sampling, Solutia Inc. W.G. Krummrich Facility, prepared by URS Corporation, May 2009.

URS (2009) 2nd Quarter 2009 Data Report, Illinois Route 3 Drum Site Groundwater Sampling, Solutia Inc. W.G. Krummrich Facility, prepared by URS Corporation, August 2009.

URS (2009) 3rd Quarter 2009 Data Report, Illinois Route 3 Drum Site Groundwater Sampling, Solutia Inc. W.G. Krummrich Facility, prepared by URS Corporation, November 2009.

URS (2010) 4th Quarter 2009 Data Report, Illinois Route 3 Drum Site Groundwater Sampling, Solutia Inc. W.G. Krummrich Facility, prepared by URS Corporation, February 2010.

URS (2010) 1st Quarter 2010 Data Report, Illinois Route 3 Drum Site Groundwater Sampling, Solutia Inc. W.G. Krummrich Facility, prepared by URS Corporation, April 2010.

URS (2010) 2nd Quarter 2010 Data Report, Illinois Route 3 Drum Site Groundwater Sampling, Solutia Inc. W.G. Krummrich Facility, prepared by URS Corporation, July 2010.

van Agerten, M.H., S. Keuning, and D.B. Janssen, 1998, *Handbook on Biodegradation and Biological Treatments of Hazardous Organic Compounds*, Kluwer Academic Publishers, Norwell, MA.

Wiedemeier, T.H., M. A. Swanson, D. E. Moutoux, E. K. Gordon, J. T. Wilson, B. H. Wilson, D. H. Kampbell, P. E. Haas, R. N. Miller, J. E. Hansen, and F. H. Chapelle (1998) Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Ground Water, National Risk Management Research Laboratory, Office of Research and Development, U.S. Environmental Protection Agency, Cincinnati, Ohio, EPA Report # EPA/600/R-98/128.

Wiedemeier, T. H., J.T. Wilson, D.H. Kampbell, R.N. Miller, and J.E. Hansen (1999) Technical Protocol for Implementing Intrinsic Remediation With Long-Term Monitoring for Natural Attenuation of Fuel Contamination Dissolved in Groundwater, Volume I. Technical Report prepared for Air Force Center for Environmental Excellence, Technology Transfer Division. March 8, 1999.

URS

ATTACHMENTS

FIGURES

Figure 1: Site Map

Figure 2A: GM-31A: Trends in COI, Electron Acceptors, and Transformation Products over Time

Figure 2B: GM-58A: Trends in COI, Electron Acceptors, and Transformation Products over Time

Figure 3: Trends in COI, Electron Acceptors, and Transformation Products over Distance Between Monitoring Wells GM-31A and GM-58A

ATTACHMENT A

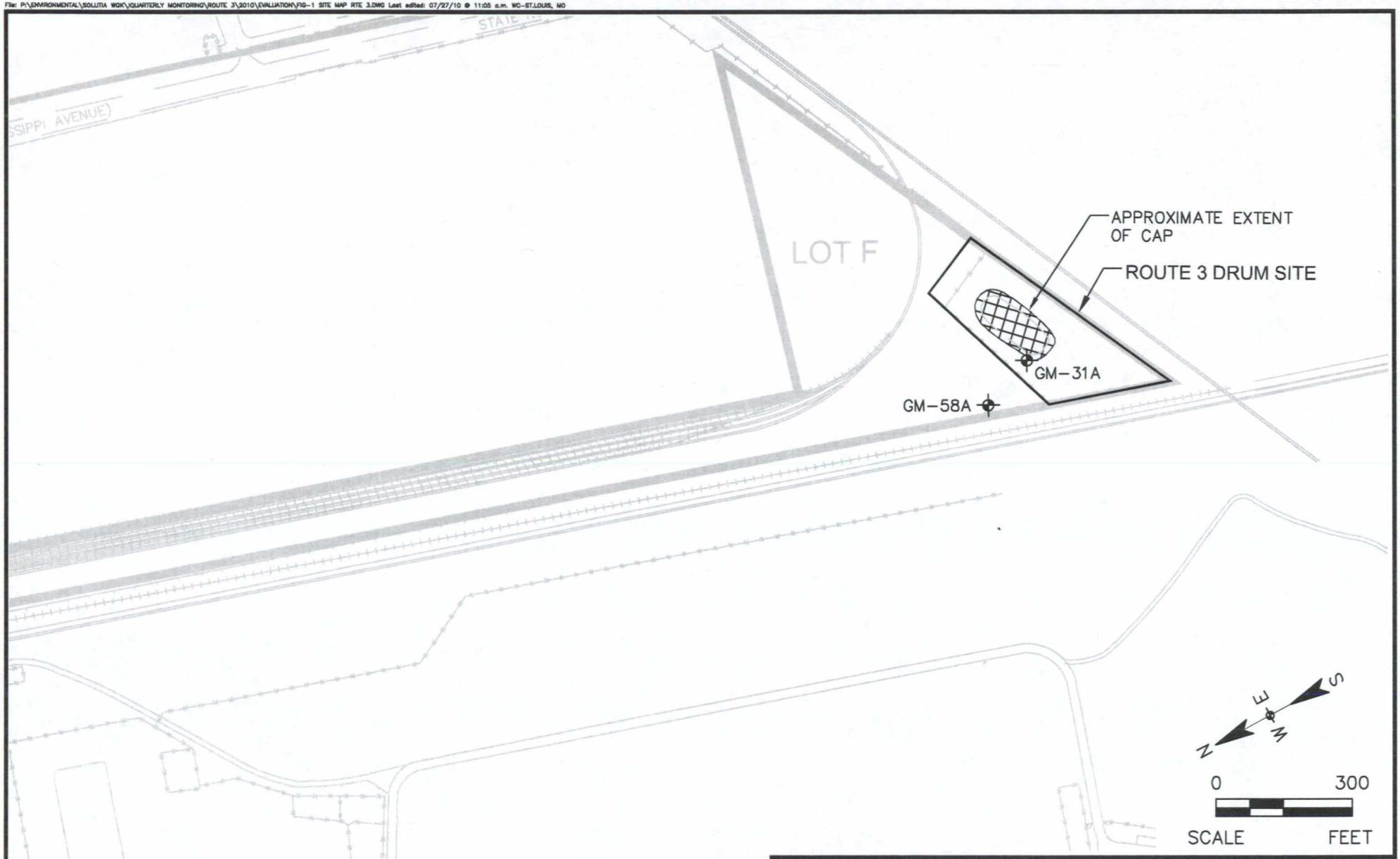
Evaluation of Monitoring Well Data 3Q08 through 2Q10

ATTACHMENT B

Mann-Kendall Analysis of MNA Data 3Q08 through 2Q10

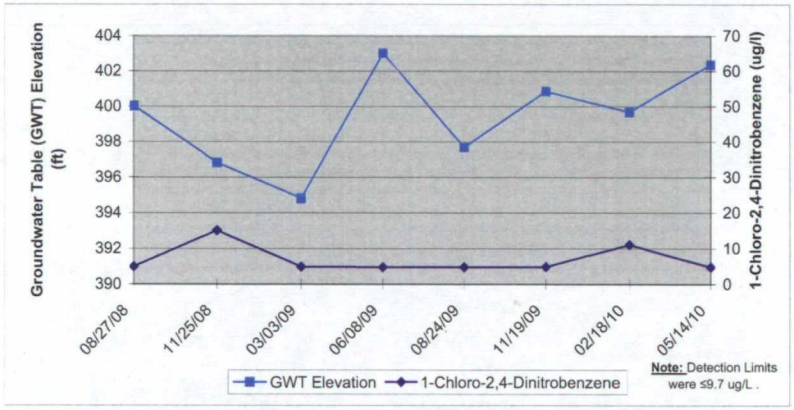
Figures

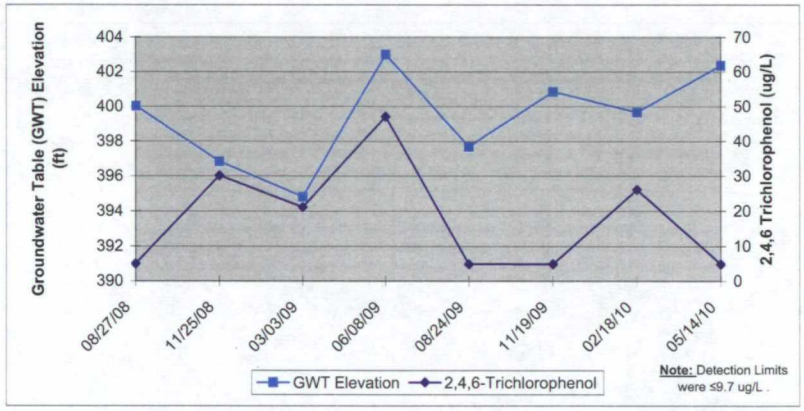
File: P:\ENVIRONMENTAL\SOLUTIA WQK\QUARTERLY MONITORING\ROUTE 3\2010\EVALUATION\FIG-1 SITE MAP RTE 3.DWG Last edited: 07/27/10 @ 11:05 a.m. WC-ST.LOUIS, MO

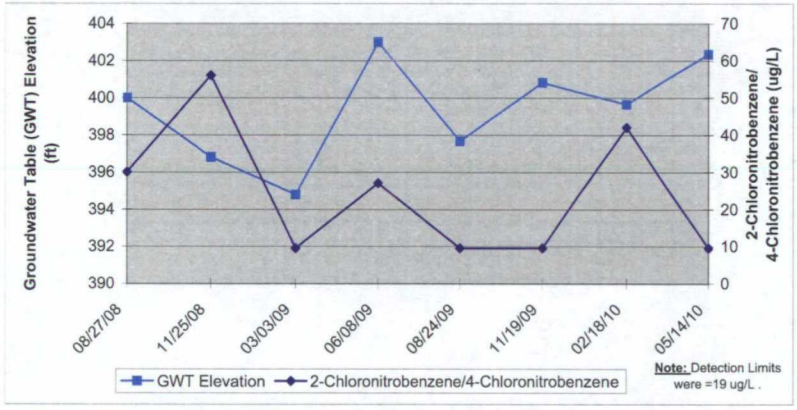


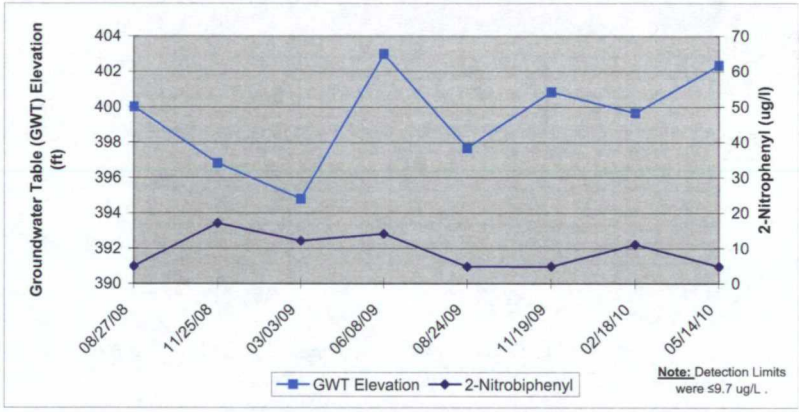
ILLINOIS ROUTE 3 DRUM SITE GROUNDWATER DATA EVALUATION W.G. KRUMMRICH FACILITY SAUGET, ILLINOIS	PROJECT NO. 21562046
URS	
DRN. BY: dab July 2010 DSGN. BY: ekf CHKD. BY:	Site Map
	FIG. NO. 1

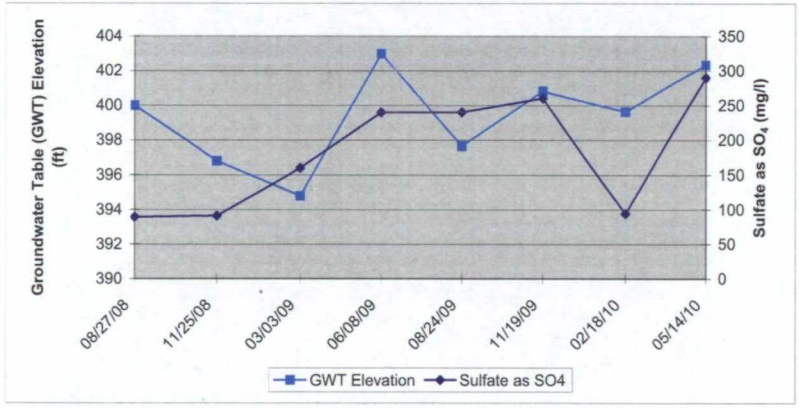
Trends in COI, Electron Acceptors, and Transformation Products over Time
Monitoring Well GM-31A











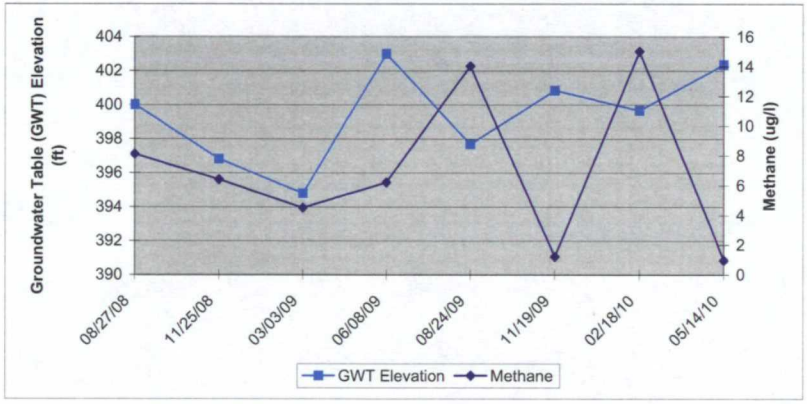
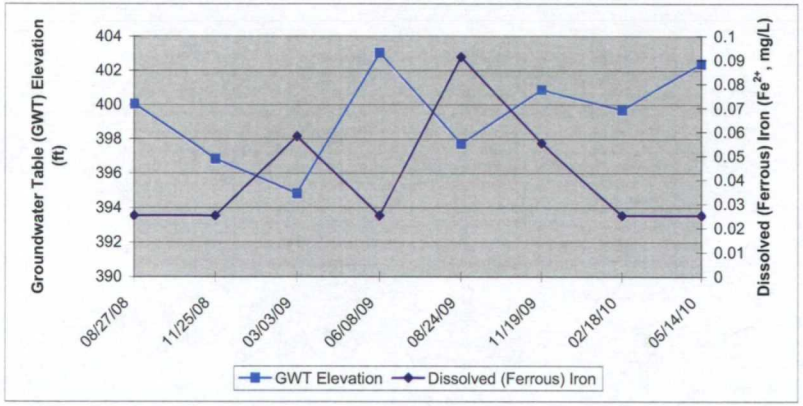
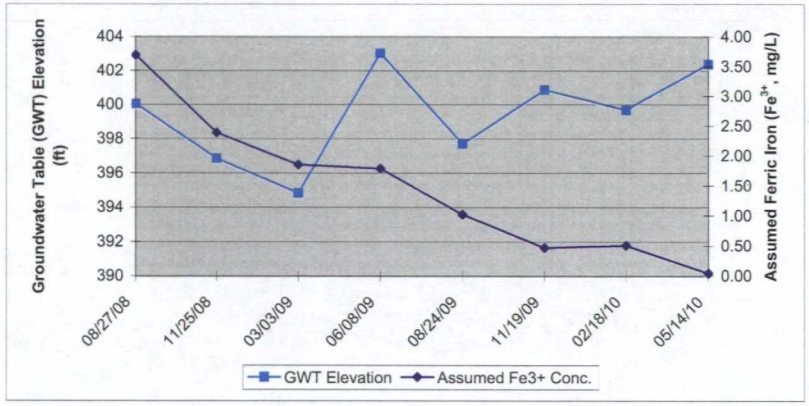
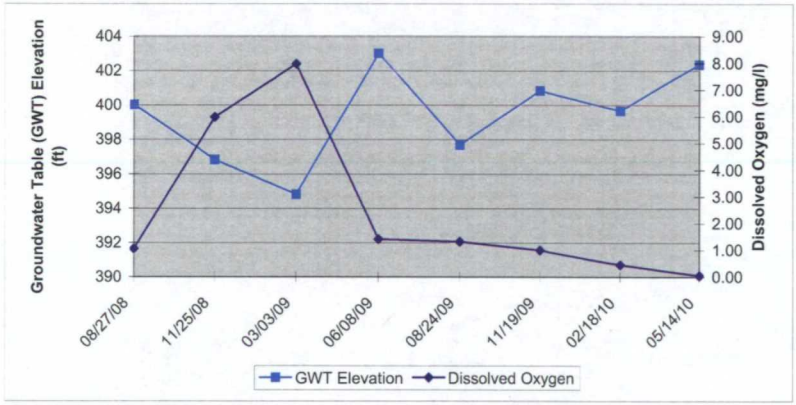


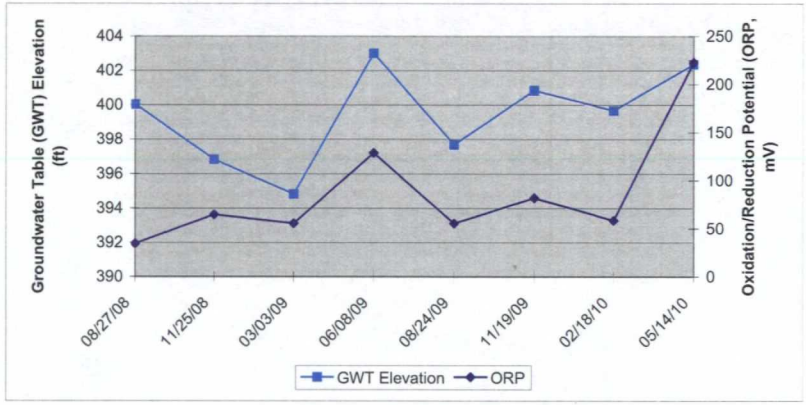
FIGURE 2A

Trends in COI, Electron Acceptors, and Transformation Products over Time
Monitoring Well GM-31A









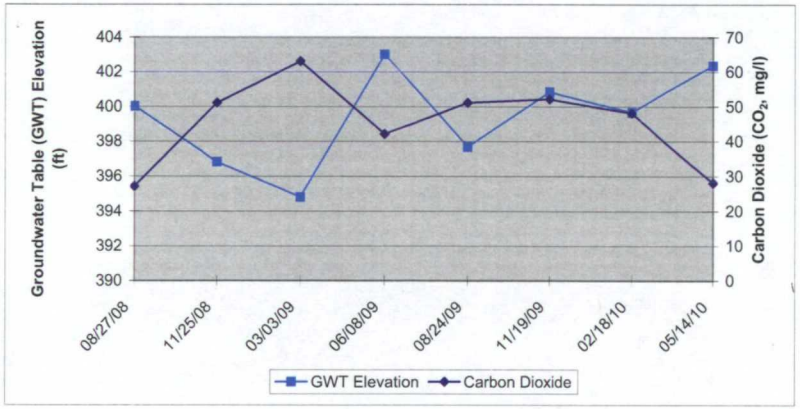
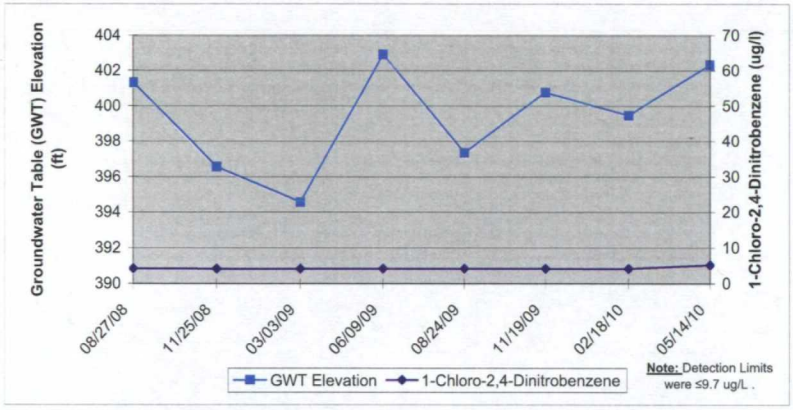
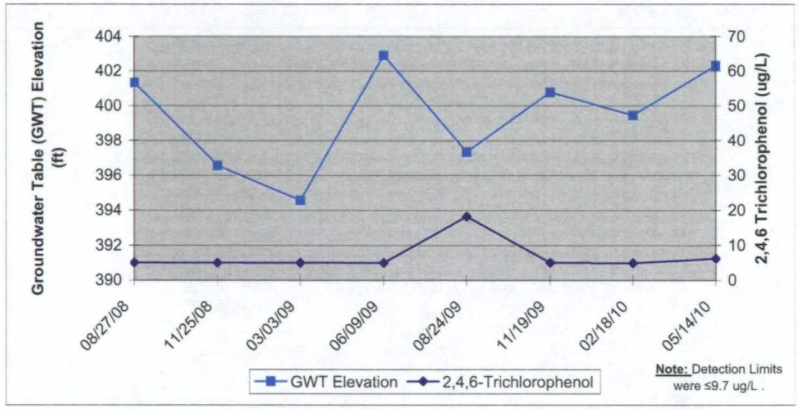
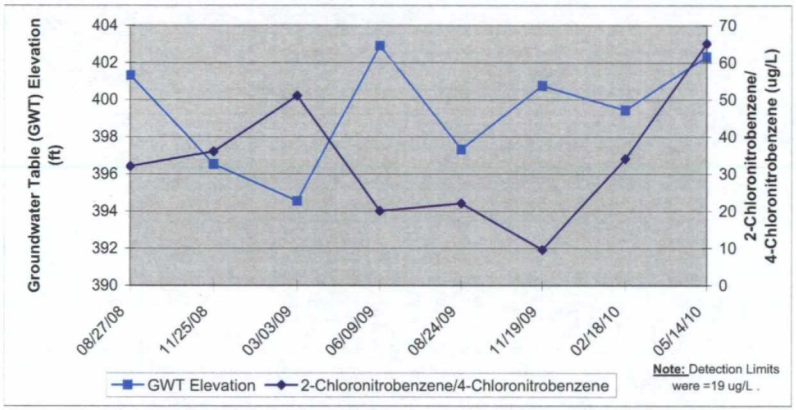


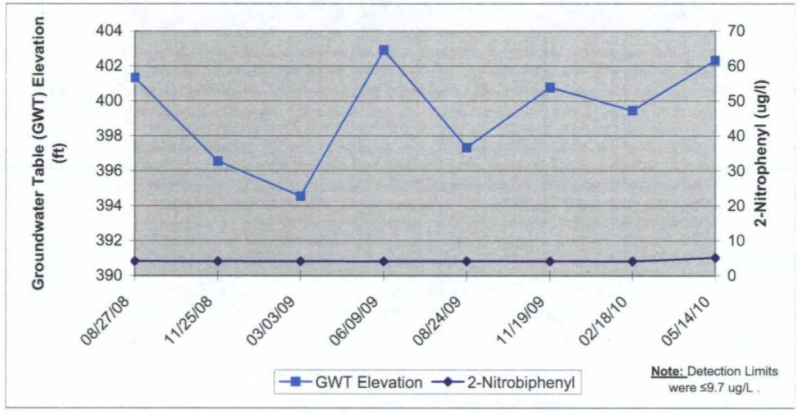
FIGURE 2A

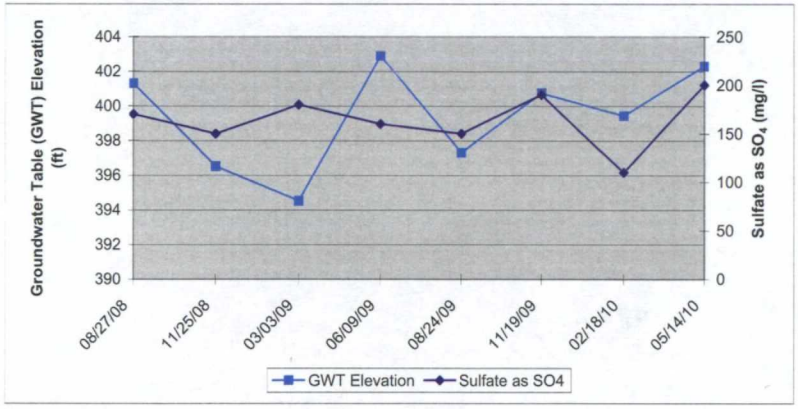
Trends in COI, Electron Acceptors, and Transformation Products over Time
Monitoring Well GM-58A

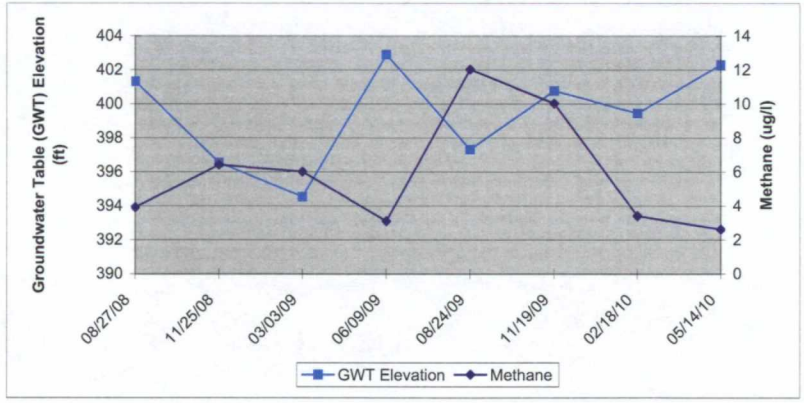




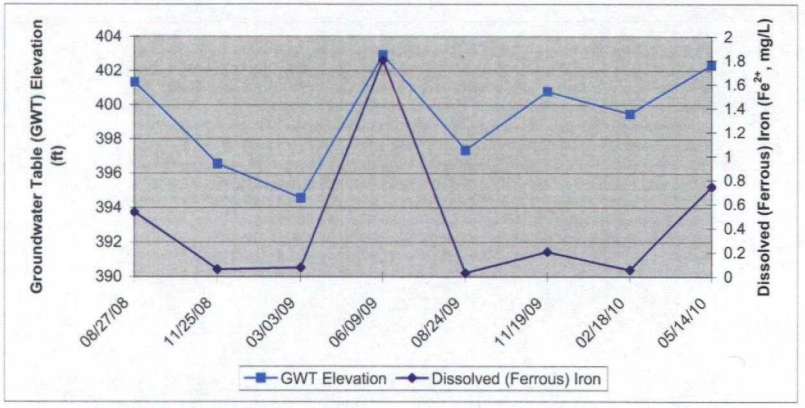


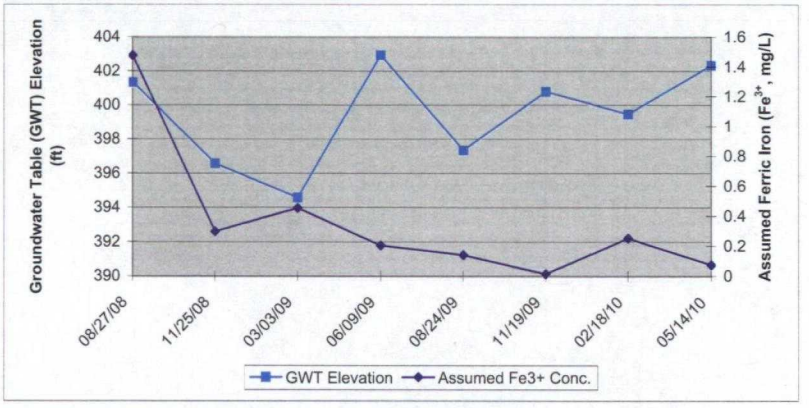


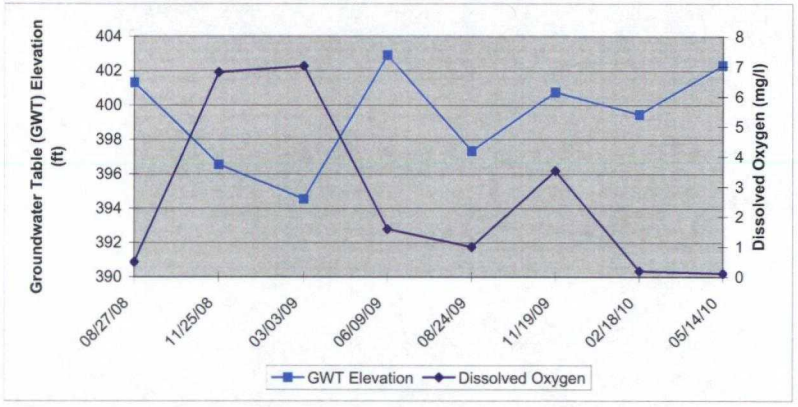


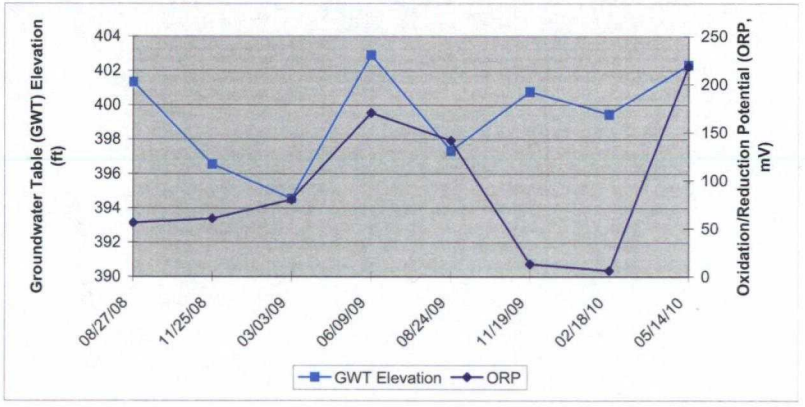


Trends in COI, Electron Acceptors, and Transformation Products over Time
Monitoring Well GM-58A









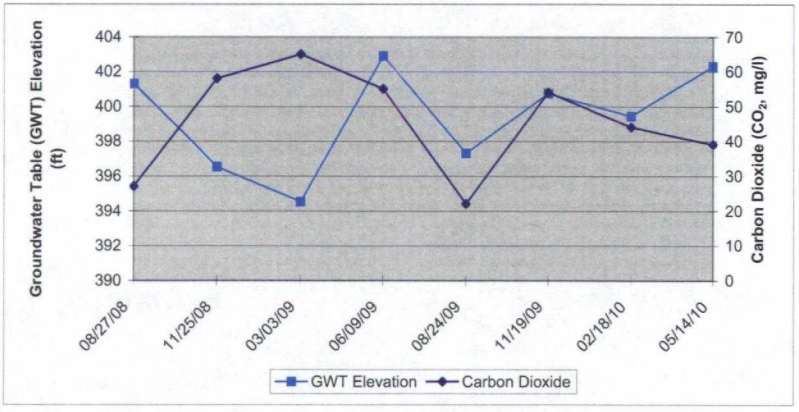
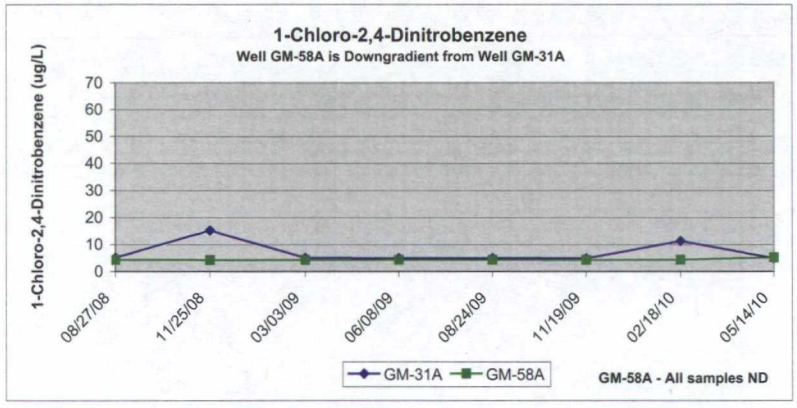
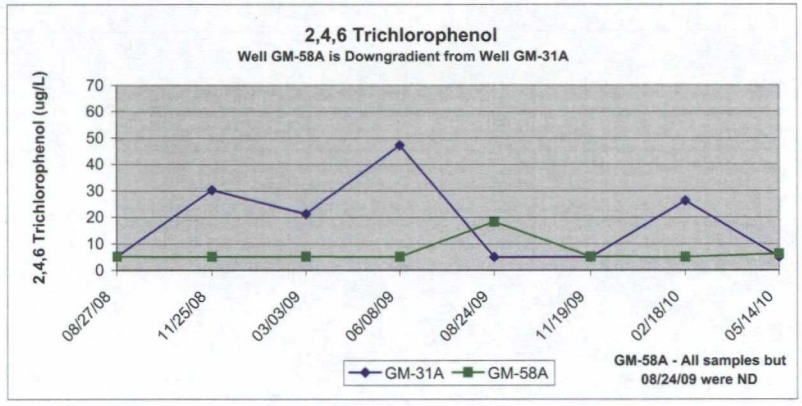
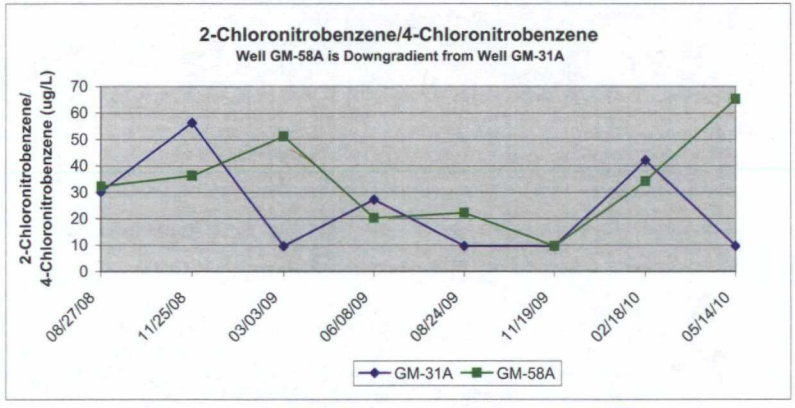


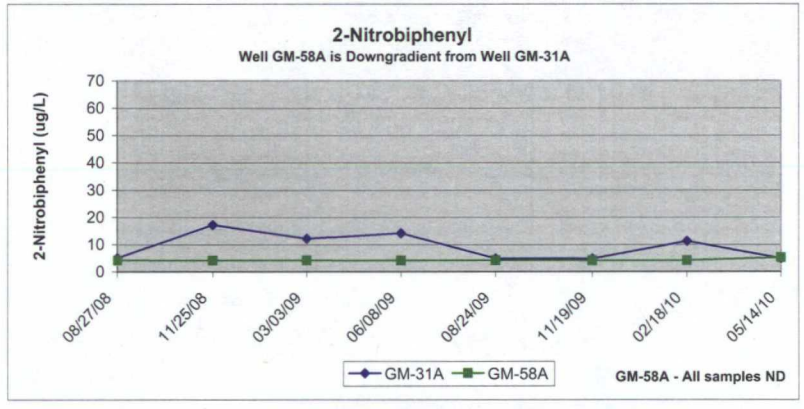
FIGURE 2B

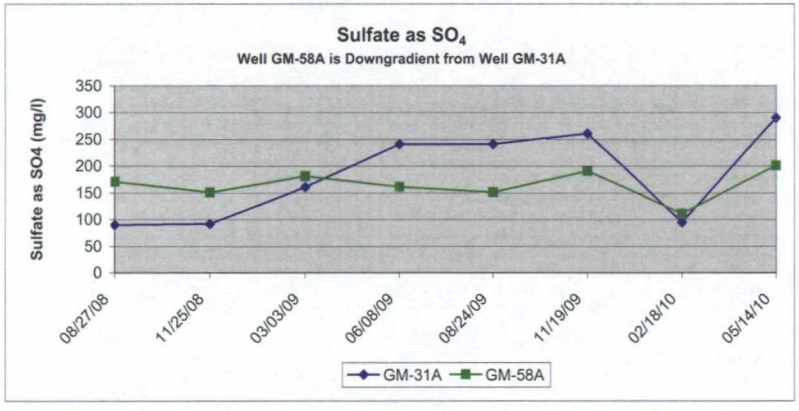
Trends in COI, Electron Acceptors, and Transformation Products over Distance
Monitoring Well GM-31A (Upgradient) to Monitoring Well GM-58A (Downgradient)

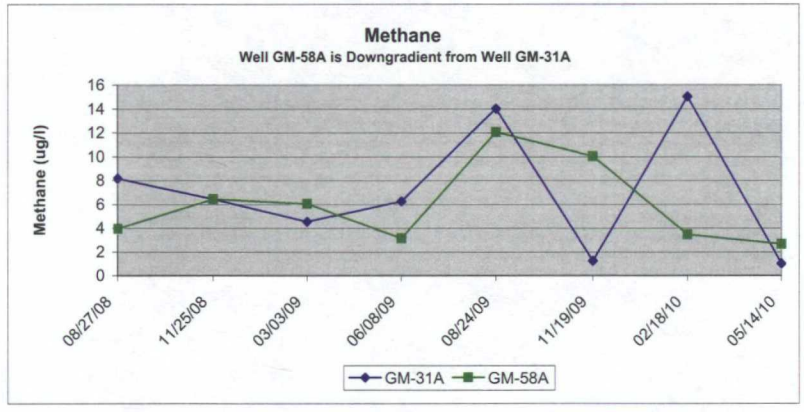




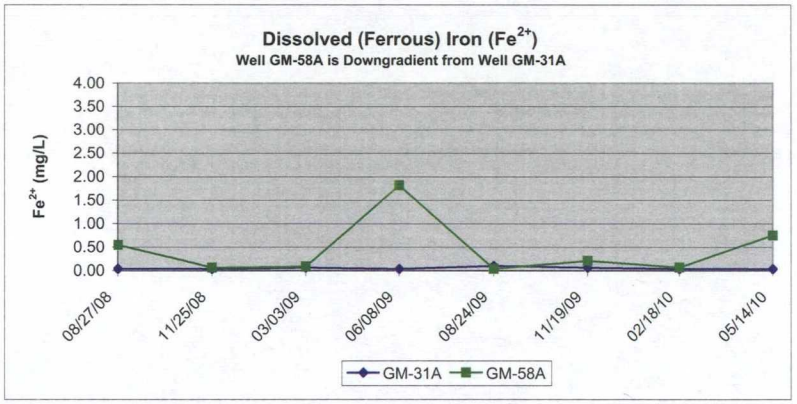


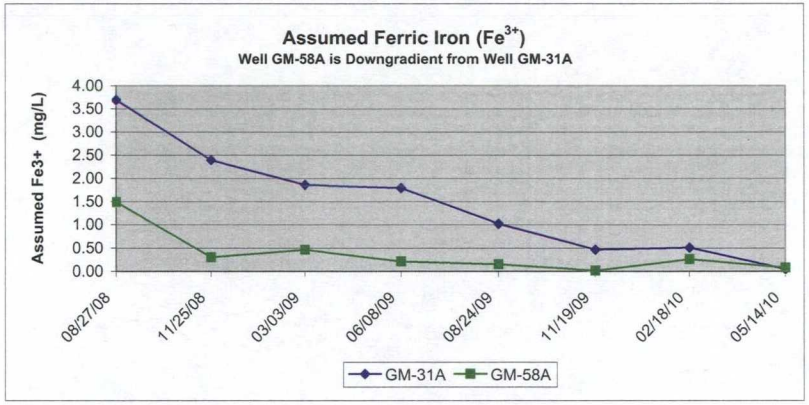


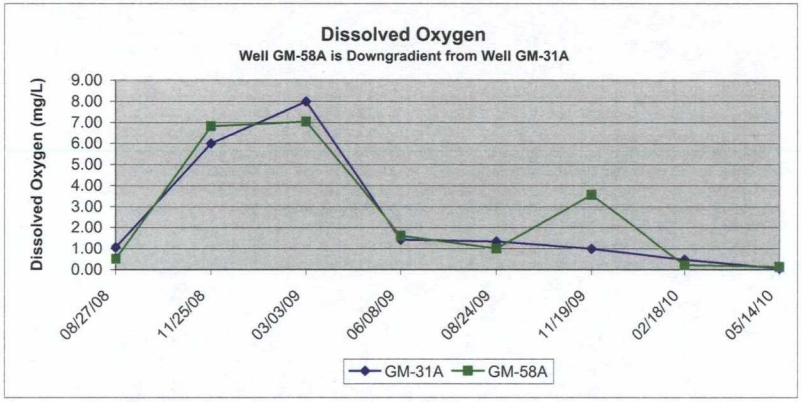


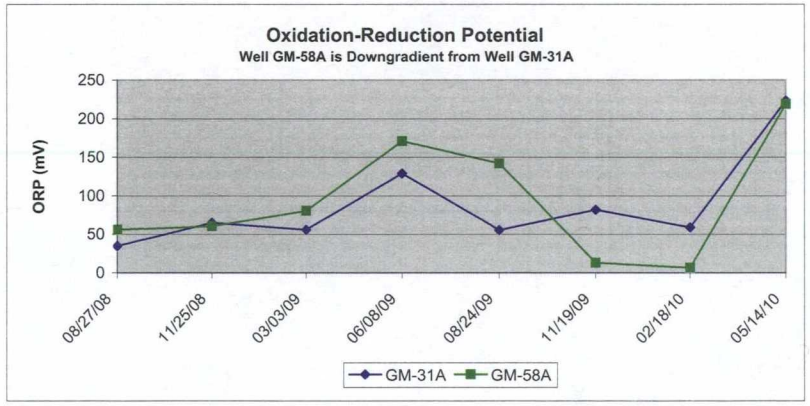


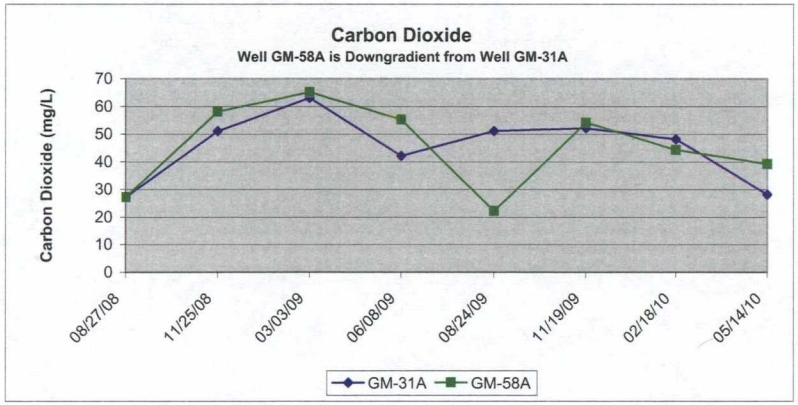
Trends in COI, Electron Acceptors, and Transformation Products over Distance
Monitoring Well GM-31A (Upgradient) to Monitoring Well GM-58A (Downgradient)











Attachment A

ATTACHMENT A
Route 3 Drum Site -- Constituents of Interest and MNA Parameters
MNA Evalaution 3Q08 through 2Q10

				3rd Quarter 2008	4th Quarter 2008	1st Quarter 2009	2nd Quarter 2009
Well ID	**Units**	**Chemical Group**	**Chemical**	**Result**	**Result**	**Result**	**Result**
Date				**08/27/08**	**11/25/08**	**03/03/09**	**06/08/09**
Groundwater Elev,	**feet**			**399.99**	**396.8**	**394.78**	**402.98**
GM-31A	ug/L	SVOCs	1-Chloro-2,4-Dinitrobenzene	4.85	15	4.85	4.7
GM-31A	ug/L	SVOCs	2,4,6-Trichlorophenol	4.85	30	21	47
GM-31A	ug/L	SVOCs	2-Chloronitrobenzene/4-Chloronitrobenzene	30	56	9.5	27
GM-31A	ug/L	SVOCs	2-Nitrobiphenyl	4.85	17	12	14
GM-31A	ug/L	Other Parameters	Methane	8.1	6.4	4.5	6.2
GM-31A	mg/L	Other Parameters	Alkalinity	510	520	490	490
GM-31A	mg/L	Other Parameters	Carbon Dioxide	27	51	63	42
GM-31A	mg/L	Other Parameters	Chloride	38	46	81	77
GM-31A	mg/L	Other Parameters	Nitrogen, Nitrate	4.4	7.2	0.27	1.7
GM-31A	mg/L	Other Parameters	Sulfate as SO4	89	91	160	240
GM-31A	mg/L	Other Parameters	Total Organic Carbon	3.7	3.4	3.6	3.8
GM-31A-F	mg/L	Other Parameters	Total Organic Carbon (Filtered)	4.1	2.9	3.1	3.3
GM-31A	mg/L	Metals	Iron	3.7	2.4	1.9	1.8
GM-31A-F	mg/L	Metals	Iron, Dissolved	0.025	0.025	0.058	0.025
GM-31A	mg/L	Metals	Assumed Fe^{3+} Conc.	3.68	2.38	1.84	1.78
GM-31A	mg/L	Metals	Manganese	0.86	1	1.1	0.86
GM-31A-F	mg/L	Metals	Manganese, Dissolved	0.8	1.2	1	0.84
GM-31A	mg/L	Field	DO	1.04	5.97	7.96	1.40
GM-31A	mV	Field	ORP	33.80	64.20	55.10	128.30

ATTACHMENT A
Route 3 Drum Site -- Constituents of Interest and MNA Parameters
MNA Evalaution 3Q08 through 2Q10

				3rd Quarter 2008	4th Quarter 2008	1st Quarter 2009	2nd Quarter 2009
Well ID	**Units**	**Chemical Group**	**Chemical**	**Result**	**Result**	**Result**	**Result**
Date				**8/27/2008**	**11/25/2008**	**3/3/2009**	**6/8/2009**
Groundwater Elev,	**feet**			**399.99**	**396.8**	**394.78**	**402.98**
GM-31A-DUP	ug/L	SVOCs	1-Chloro-2,4-Dinitrobenzene	4.85	16	4.85	4.7
GM-31A-DUP	ug/L	SVOCs	2,4,6-Trichlorophenol	13	29	19	44
GM-31A-DUP	ug/L	SVOCs	2-Chloronitrobenzene/4-Chloronitrobenzene	32	58	9.5	27
GM-31A-DUP	ug/L	SVOCs	2-Nitrobiphenyl	4.85	16	12	14
GM-31A-DUP	ug/L	Other Parameters	Methane	9			
GM-31A-DUP	mg/L	Other Parameters	Alkalinity	500			
GM-31A-DUP	mg/L	Other Parameters	Carbon Dioxide	29			
GM-31A-DUP	mg/L	Other Parameters	Chloride	37			
GM-31A-DUP	mg/L	Other Parameters	Nitrogen, Nitrate	4.4			
GM-31A-DUP	mg/L	Other Parameters	Sulfate as SO4	87			
GM-31A-DUP	mg/L	Other Parameters	Total Organic Carbon	3.8			
GM-31A-F-DUP	mg/L	Other Parameters	Total Organic Carbon (Filtered)	3.1			
GM-31A-DUP	mg/L	Metals	Iron	2.5			
GM-31A-DUP	mg/L	Metals	Manganese	0.85			
GM-31A-F-DUP	mg/L	Metals	Manganese, Dissolved	0.8			

ATTACHMENT A
Route 3 Drum Site -- Constituents of Interest and MNA Parameters
MNA Evalaution 3Q08 through 2Q10

				3rd Quarter 2008	4th Quarter 2008	1st Quarter 2009	2nd Quarter 2009
Well ID	**Units**	**Chemical Group**	**Chemical**	**Result**	**Result**	**Result**	**Result**
Date				**8/27/2008**	**11/25/2008**	**3/3/2009**	**6/9/2009**
Groundwater Elev,	**feet**			**401.29**	**396.52**	**394.52**	**402.88**
GM-58A	ug/L	SVOCs	1-Chloro-2,4-Dinitrobenzene	4	4	4	4
GM-58A	ug/L	SVOCs	2,4,6-Trichlorophenol	4.85	4.85	4.85	4.85
GM-58A	ug/L	SVOCs	2-Chloronitrobenzene/4-Chloronitrobenzene	32	36	51	20
GM-58A	ug/L	SVOCs	2-Nitrobiphenyl	4	4	4	4
GM-58A	ug/L	Other Parameters	Methane	3.9	6.4	6	3.1
GM-58A	mg/L	Other Parameters	Alkalinity	530	530	550	530
GM-58A	mg/L	Other Parameters	Carbon Dioxide	27	58	65	55
GM-58A	mg/L	Other Parameters	Chloride	82	100	120	120
GM-58A	mg/L	Other Parameters	Nitrogen, Nitrate	0.425	0.65	0.025	0.025
GM-58A	mg/L	Other Parameters	Sulfate as SO4	170	150	180	160
GM-58A	mg/L	Other Parameters	Total Organic Carbon	3.3	3.6	4.2	4.4
GM-58A-F	mg/L	Other Parameters	Total Organic Carbon (Filtered)	2.8	2.6	3.8	3.1
GM-58A	mg/L	Metals	Iron	2	0.35	0.52	2
GM-58A-F	mg/L	Metals	Iron, Dissolved	0.53	0.058	0.072	1.8
GM-58A	mg/L	Metals	Assumed Fe^{3+} Conc.	1.47	0.292	0.448	0.2
GM-58A	mg/L	Metals	Manganese	1.8	1.4	1.6	2.3
GM-58A-F	mg/L	Metals	Manganese, Dissolved	1.8	1.5	1.6	2.2
GM-58A	mg/L	Field	DO	0.48	6.8	7.01	1.58
GM-58A	mV	Field	ORP	55.3	59.9	79.7	169.9

ATTACHMENT A
Route 3 Drum Site -- Constituents of Interest and MNA Parameters
MNA Evalaution 3Q08 through 2Q10

				3rd Quarter 2009	4th Quarter 2009	1st Quarter 2010	2nd Quarter 2010
Well ID	**Units**	**Chemical Group**	**Chemical**	**Result**	**Result**	**Result**	**Result**
Date				**08/24/09**	**11/19/09**	**02/18/10**	**05/14/10**
Groundwater Elev,	**feet**			**397.65**	**400.81**	**399.64**	**402.33**
GM-31A	ug/L	SVOCs	1-Chloro-2,4-Dinitrobenzene	4.7	4.75	11	4.7
GM-31A	ug/L	SVOCs	2,4,6-Trichlorophenol	4.7	4.75	26	4.7
GM-31A	ug/L	SVOCs	2-Chloronitrobenzene/4-Chloronitrobenzene	9.5	9.5	42	9.5
GM-31A	ug/L	SVOCs	2-Nitrobiphenyl	4.7	4.75	11	4.7
GM-31A	ug/L	Other Parameters	Methane	14	1.2	15	0.95
GM-31A	mg/L	Other Parameters	Alkalinity	500	410	490	450
GM-31A	mg/L	Other Parameters	Carbon Dioxide	51	52	48	28
GM-31A	mg/L	Other Parameters	Chloride	84	84	30	88
GM-31A	mg/L	Other Parameters	Nitrogen, Nitrate	1.5	3.8	1.1	3.1
GM-31A	mg/L	Other Parameters	Sulfate as SO4	240	260	94	290
GM-31A	mg/L	Other Parameters	Total Organic Carbon	4	3.7	3	3.9
GM-31A-F	mg/L	Other Parameters	Total Organic Carbon (Filtered)	3.8	3.5	3	3.8
GM-31A	mg/L	Metals	Iron	1.1	0.51	0.52	0.058
GM-31A-F	mg/L	Metals	Iron, Dissolved	0.091	0.055	0.025	0.025
GM-31A	mg/L	Metals	Assumed Fe^{3+} Conc.	1.01	0.46	0.50	0.03
GM-31A	mg/L	Metals	Manganese	0.96	0.93	1.1	0.86
GM-31A-F	mg/L	Metals	Manganese, Dissolved	0.89	0.89	1	0.86
GM-31A	mg/L	Field	DO	1.30	0.98	0.44	0.03
GM-31A	mV	Field	ORP	54.80	81.40	58.00	222.20

ATTACHMENT A
Route 3 Drum Site -- Constituents of Interest and MNA Parameters
MNA Evalaution 3Q08 through 2Q10

				3rd Quarter 2009	4th Quarter 2009	1st Quarter 2010	2nd Quarter 2010
Well ID	**Units**	**Chemical Group**	**Chemical**	**Result**	**Result**	**Result**	**Result**
Date				**8/24/2009**	**11/19/2009**	**2/18/2010**	**5/14/2010**
Groundwater Elev,	**feet**			**397.65**	**400.81**	**399.64**	**402.33**
GM-31A-DUP	ug/L	SVOCs	1-Chloro-2,4-Dinitrobenzene	4.7	4.75	12	4.85
GM-31A-DUP	ug/L	SVOCs	2,4,6-Trichlorophenol	4.7	4.75	27	4.85
GM-31A-DUP	ug/L	SVOCs	2-Chloronitrobenzene/4-Chloronitrobenzene	9.5	9.5	44	9.5
GM-31A-DUP	ug/L	SVOCs	2-Nitrobiphenyl	4.7	4.75	11	4.85
GM-31A-DUP	ug/L	Other Parameters	Methane				
GM-31A-DUP	mg/L	Other Parameters	Alkalinity				
GM-31A-DUP	mg/L	Other Parameters	Carbon Dioxide				
GM-31A-DUP	mg/L	Other Parameters	Chloride				
GM-31A-DUP	mg/L	Other Parameters	Nitrogen, Nitrate				
GM-31A-DUP	mg/L	Other Parameters	Sulfate as SO4				
GM-31A-DUP	mg/L	Other Parameters	Total Organic Carbon				
GM-31A-F-DUP	mg/L	Other Parameters	Total Organic Carbon (Filtered)				
GM-31A-DUP	mg/L	Metals	Iron				
GM-31A-DUP	mg/L	Metals	Manganese				
GM-31A-F-DUP	mg/L	Metals	Manganese, Dissolved				

ATTACHMENT A
Route 3 Drum Site -- Constituents of Interest and MNA Parameters
MNA Evalaution 3Q08 through 2Q10

				3rd Quarter 2009	4th Quarter 2009	1st Quarter 2010	2nd Quarter 2010
Well ID	**Units**	**Chemical Group**	**Chemical**	**Result**	**Result**	**Result**	**Result**
Date				**8/24/2009**	**11/19/2009**	**2/18/2010**	**5/14/2010**
Groundwater Elev,	**feet**			**397.29**	**400.73**	**399.42**	**402.28**
GM-58A	ug/L	SVOCs	1-Chloro-2,4-Dinitrobenzene	4	4	4	5
GM-58A	ug/L	SVOCs	2,4,6-Trichlorophenol	18	4.85	4.75	6
GM-58A	ug/L	SVOCs	2-Chloronitrobenzene/4-Chloronitrobenzene	22	9.5	34	65
GM-58A	ug/L	SVOCs	2-Nitrobiphenyl	4	4	4	5
GM-58A	ug/L	Other Parameters	Methane	12	10	3.4	2.6
GM-58A	mg/L	Other Parameters	Alkalinity	540	460	510	490
GM-58A	mg/L	Other Parameters	Carbon Dioxide	22	54	44	39
GM-58A	mg/L	Other Parameters	Chloride	97	110	52	94
GM-58A	mg/L	Other Parameters	Nitrogen, Nitrate	0.18	0.11	1.5	0.025
GM-58A	mg/L	Other Parameters	Sulfate as SO4	150	190	110	200
GM-58A	mg/L	Other Parameters	Total Organic Carbon	4.4	3.7	2.6	3.7
GM-58A-F	mg/L	Other Parameters	Total Organic Carbon (Filtered)	6.3	3.3	2.6	3.5
GM-58A	mg/L	Metals	Iron	0.16	0.21	0.3	0.81
GM-58A-F	mg/L	Metals	Iron, Dissolved	0.025	0.2	0.052	0.74
GM-58A	mg/L	Metals	Assumed Fe^{3+} Conc.	0.135	0.01	0.248	0.07
GM-58A	mg/L	Metals	Manganese	1.6	1.7	1.4	1.9
GM-58A-F	mg/L	Metals	Manganese, Dissolved	1.6	1.7	1.4	1.8
GM-58A	mg/L	Field	DO	0.98	3.52	0.18	0.1
GM-58A	mV	Field	ORP	141	12.5	5.9	218.1

Notes:

Results in Red are non-detects, half of detection limit

Blanks indicate rounds where a sample was not collected or analyzed.

Attachment B

ATTACHMENT B

Mann-Kendall Analysis of MNA Data 3Q08 through 2Q10
Monitoring Well GM-31A

State of Wisconsin — **Mann-Kendall Statistical Test**
Department of Natural Resources — **Form 4400-215 (2/2001)**
Remediation and Redevelopment Program — **Revised to Evaluate Trend at ≥ 95% Confidence Level**

Notice: This form is the DNR supplied spreadsheet referenced in Appendices A of Comm 46 and NR 746, Wis. Adm. Code. It is provided to consultants as an optional tool for groundwater contaminant trend analysis to support site closure requests under s. Comm 46.07, Comm 46.08, NR 746.07, NR 746.08, Wis. Adm. Code. Use this form or a manual method when seeking case closure under those rules. Earlier versions of this form should not be used.

Instructions: Do not change formulas or other information in cells with a blue background, only cells with a yellow background are used for data entry. To use the spreadsheet, provide at least four rounds and not more than ten rounds of data that is not seasonally affected. Use consistent units. The spreadsheet contains several error checks, and a data entry error may cause "DATA ERR" or "DATE ERR" to be displayed. Dates that are not consecutive will show an error message and will not display the test results. The spreadsheet tests the data for both increasing and decreasing trends at both 80 percent and 90 percent confidence levels. If a declining trend is present at 80 percent but not at 90 percent, a site is still eligible for closure under Comm 46 and NR 746 provided that other conditions in those rules are met. If an increasing or decreasing trend is not present, an additional coefficient of variation test is used to test for stability, as proposed by Wiedemeier et al, 1999. For additional information, refer to the Interim Guidance on Natural Attenuation for Petroleum Releases, dated October 1999. Refer to the guidance for recommendations on data entry for non-detect values.

Site Name = Solutia WGK Site				BRRTS No. =		Well Number = GM-31A	
	Compound ->	1-Chloro-2,4-Dinitrobenzene	2,4,6-Trichlorophenol	2-Chloro-nitrobenzene / 4-Chloro-nitrobenzene	2-Nitrobiphenyl		
Event Number	Sampling Date (most recent last)	Concentration (blank if no data; Red if ND/2 used)	Concentration (blank if no data; Red if ND/2 used)	Concentration (blank if no data; Red if ND/2 used)	Concentration (blank if no data; Red if ND/2 used)	Concentration (blank if no data; Red if ND/2 used)	Concentration (blank if no data; Red if ND/2 used)
1	27-Aug-08	4.85	4.85	30	4.85		
2	25-Nov-08	15	30	56	17		
3	3-Mar-09	4.85	21	9.5	12		
4	24-Aug-09	4.7	4.7	9.5	4.7		
5	18-Feb-10	11	26	42	11		
6							
7							
8							
9							
10							
	Mann Kendall Statistic (S) =	-1.0	0.0	-1.0	-2.0	0.0	0.0
	Number of Rounds (n) =	5	5	5	5	0	0
	Average =	8.08	17.31	29.40	9.91	#DIV/0!	#DIV/0!
	Standard Deviation =	4.709	11.879	20.364	5.210	#DIV/0!	#DIV/0!
	Coefficient of Variation(CV)=	0.583	0.686	0.693	0.526	#DIV/0!	#DIV/0!
Error Check, Blank if No Errors Detected						n<4	n<4
Trend ≥ 80% Confidence Level		No Trend	No Trend	No Trend	No Trend	n<4	n<4
Trend ≥ 90% Confidence Level		No Trend	No Trend	No Trend	No Trend	n<4	n<4
Trend ≥ 95% Confidence Level		No Trend	No Trend	No Trend	No Trend	n<4	n<4
Stability Test, If No Trend Exists at 80% Confidence Level		CV <= 1 STABLE	CV <= 1 STABLE	CV <= 1 STABLE	CV <= 1 STABLE	n<4 n<4	n<4 n<4
	Data Entry By =	PWS	Date =	16-Jul-10	Checked By =	WAN	

ATTACHMENT B

Mann-Kendall Analysis of MNA Data 3Q08 through 2Q10
Monitoring Well GM-58A

State of Wisconsin
Department of Natural Resources
Remediation and Redevelopment Program

Mann-Kendall Statistical Test
Form 4400-215 (2/2001)
Revised to Evaluate Trend at ≥ 95% Confidence Level

Notice: This form is the DNR supplied spreadsheet referenced in Appendices A of Comm 46 and NR 746, Wis. Adm. Code. It is provided to consultants as an optional tool for groundwater contaminant trend analysis to support site closure requests under s. Comm 46.07, Comm 46.08, NR 746.07, NR 746.08, Wis. Adm. Code. Use this form or a manual method when seeking case closure under those rules. Earlier versions of this form should not be used.

Instructions: Do not change formulas or other information in cells with a blue background, only cells with a yellow background are used for data entry. To use the spreadsheet, provide at least four rounds and not more than ten rounds of data that is not seasonally affected. Use consistent units. The spreadsheet contains several error checks, and a data entry error may cause "DATA ERR" or "DATE ERR" to be displayed. Dates that are not consecutive will show an error message and will not display the test results. The spreadsheet tests the data for both increasing and decreasing trends at both 80 percent and 90 percent confidence levels. If a declining trend is present at 80 percent but not at 90 percent, a site is still eligible for closure under Comm 46 and NR 746 provided that other conditions in those rules are met. If an increasing or decreasing trend is not present, an additional coefficient of variation test is used to test for stability, as proposed by Wiedemeier et al, 1999. For additional information, refer to the Interim Guidance on Natural Attenuation for Petroleum Releases, dated October 1999. Refer to the guidance for recommendations on data entry for non-detect values.

Site Name = Solutia WGK Site				BRRTS No. =		Well Number = GM-58A	
	Compound ->	1-Chloro-2,4-Dinitrobenzene	2,4,6-Trichlorophenol	2-Chloro-nitrobenzene / 4-Chloro-nitrobenzene	2-Nitrobiphenyl		
Event Number	Sampling Date (most recent last)	Concentration (blank if no data; Red if ND/2 used)	Concentration (blank if no data; Red if ND/2 used)	Concentration (blank if no data; Red if ND/2 used)	Concentration (blank if no data; Red if ND/2 used)	Concentration (blank if no data; Red if ND/2 used)	Concentration (blank if no data; Red if ND/2 used)
1	27-Aug-08		4.85	32			
2	25-Nov-08		4.85	36			
3	3-Mar-09		4.85	51			
4	24-Aug-09		18	22			
5	18-Feb-10		4.75	34			
6							
7							
8							
9							
10							
	Mann Kendall Statistic (S) =	0.0	-1.0	0.0	0.0	0.0	0.0
	Number of Rounds (n) =	0	5	5	0	0	0
	Average =	#DIV/0!	7.46	35.00	#DIV/0!	#DIV/0!	#DIV/0!
	Standard Deviation =	#DIV/0!	5.892	10.440	#DIV/0!	#DIV/0!	#DIV/0!
	Coefficient of Variation(CV)=	#DIV/0!	0.790	0.298	#DIV/0!	#DIV/0!	#DIV/0!
Error Check, Blank if No Errors Detected		n<4			n<4	n<4	n<4
Trend ≥ 80% Confidence Level		n<4	No Trend	No Trend	n<4	n<4	n<4
Trend ≥ 90% Confidence Level		n<4	No Trend	No Trend	n<4	n<4	n<4
Trend ≥ 95% Confidence Level		n<4	No Trend	No Trend	n<4	n<4	n<4
Stability Test, If No Trend Exists at 80% Confidence Level		n<4 n<4	CV <= 1 STABLE	CV <= 1 STABLE	n<4 n<4	n<4 n<4	n<4 n<4
	Data Entry By = PWS		Date = 16-Jul-10		Checked By = WAN		